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THE MANUFACTURING QUALITY OF IRRIGATED COTTON

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Introduction

For more than 15 years, the producers and shippers of irrigated American upland cotton have been faced with the problem of inducing American spinners to use and like such cotton. That they have not been entirely successful is illustrated only too clearly by the relative prices of irrigated and rain-grown cotton when landed at southeastern and New England mills. For similar grades and staples, irrigated cotton has been bought for prices ranging from 100 to 300 or 400 points below those paid for rain-grown cotton.

Is this situation due to whispering campaigns instituted by unscrupulous persons, or can it be said that it represents a true comparison of the manufacturing quality of the two growths? At the request of both the growers of irrigated cotton and a number of manufacturers, the U. S. Department of Agriculture has endeavored to unearth the facts of the case. It is my purpose today to tell you some of the things that the Department has found out about the manufacturing quality of irrigated cotton, and after having taken stock of the matter, to suggest ways and means that may assist you in solving your problem.

At this point, it should be brought out that the term "irrigated cotton" is an inadequate, if not unfortunate, choice of words to use in referring to the cotton produced in the Southwest. It bears an inference that the mere fact that the water required for the growth of cotton out here comes from irrigation ditches rather than directly from the sky, is solely responsible for all the good or bad features of any bale of cotton produced. This, of course, is not true, as we all know that temperature, sunlight, type of soil, variety of seed, ginning efficiency, and other factors all affect the quality of cotton. Then, too, it is well to remember that practically all cotton produced in Egypt is grown under irrigation, and in general this cotton seems to have been well received.

In spite of these facts, however, the upland cotton grown in California, Arizona, New Mexico, and the upper Rio Grande Valley is called "irrigated cotton", in keeping with the true American custom of assigning catchwords without always considering the effects. Because the term is so widely used, we shall continue to speak of "irrigated cotton" in our present discussion.

Sources of Information

Two methods have been employed in an effort to obtain an adequate answer to the question, "How does irrigated cotton compare in manufacturing

quality with rain-grown cotton?" The first method consisted of carefully conducted laboratory tests, made by experienced technologists and under controlled conditions, and the second, of obtaining first-hand information directly from manufacturers who have used irrigated cotton. Each method has its shortcomings, as well as its advantages. In many respects, however, one possesses what the other lacks, and a combination of the two methods has appeared to the Department to offer a fair opportunity of obtaining the desired information.

In a laboratory test, it is not practicable to make more than a small fraction of the materials that could be made from irrigated cotton. And in obtaining information from a manufacturer about his experience with such cotton, two facts must be kept in mind: First, no matter how large the mill or how experienced the manufacturer, he cannot have tried all kinds of cotton--even all kinds of irrigated cotton. Second, it must be realized that at least some mill men do not wish to seem too enthusiastic about a cotton that is cheap, when they know that too much enthusiasm might tend to raise the price of it.

Some of you may be familiar with the laboratory tests made by the Department on material from the 1939 crop. A description of the test methods used and the findings obtained have been published and for our purpose it will not be necessary to review them in detail. As each point relating to manufacturing quality is considered, the results of the test will be discussed, and pertinent information obtained from manufacturers will be compared with the laboratory findings.

As opportunities were presented during the past few weeks, visits were made to several mills, both in the Southeast and in New England, and the opinions of managers, superintendents, and research men were obtained with regard to irrigated cotton. Naturally, the identity of these mills must not be disclosed, and I shall avoid giving out definite details that might lead to their identification.

Results of Tests and Discussions

Let us now discuss the facts as brought out by the tests and in the talks with manufacturers. This may logically be done by considering some of the so-called prejudices that mill men have voiced in the past regarding irrigated cotton. To be specific, it has been said that irrigated cotton is wasty, irregular, and weak; that the yarns spun from it are rough and nappy; that the fabrics are of poor appearance; that the cotton is "hard to spin"; and that it does not take dye properly. We shall consider these factors about in that order, which is not necessarily the order of their importance.

(1) Is irrigated cotton wasty? All cotton, of course, must pass through cleaning machines, which remove as waste most of the foreign matter, such as leaf, motes, sand, and so on, as well as some fiber, comprising nap or tangled fibers, and short fiber. But is irrigated cotton abnormally wasty, as compared with rain-grown cotton? The Government tests showed some differences between the two growths, but these differences were not clear cut

nor always in the same direction. That is, the rain-grown cotton yielded less picker and card waste, grade for grade in the 1-1/16 and 1-3/32 inch lengths, and the irrigated cotton yielded less waste in the 1-1/8 inch length. In regard to this amount of waste, the California cotton in most cases was between the irrigated cotton from the Arizona-New Mexico-West Texas area and the rain-grown cotton from the Delta.

Few cotton mills have records to show picker and card waste percentages. They do, of course, keep careful records of the input and output, or the quantity of raw cotton consumed and the weight of the goods manufactured. These records would reflect any important differences in the amount of waste removed by the cleaning machines.

In our discussions with manufacturers, we did not hear any complaints that the irrigated cotton was more wasteful. One manufacturer who uses irrigated cotton for combed fabrics was extracting an average quantity of comb waste from his cotton, with excellent results. The percentage of comb waste that a mill extracts is objective; that is, it is predetermined and controlled, to produce the desired cleanliness in the product.

To summarize our information regarding the relative wastiness of irrigated and rain-grown cotton, we may say that the relationship appears to vary somewhat, but no information was obtained from mills to indicate that irrigated cotton was especially objectionable in this respect.

(2) Is irrigated cotton irregular? The term "irregularity" as applied to cotton has a number of meanings or implications. For example, it may be used to indicate variation between shipments of cotton, or it may refer to variation among bales in a given shipment, or again, among different portions of a single bale. It may refer to staple length, or to quality in general.

With such a variety of meanings for a question, the difficulties of giving a simple, definite answer are obvious. For our present purpose, however, we shall assume that irregularity refers to staple length within an even-running lot of carefully classed cotton such as any mill would like to have.

The cotton used in the laboratory tests can be considered as falling in this category. These tests showed that the irrigated samples were slightly but rather consistently less uniform in length than the rain-grown samples. The Delta samples were the most uniform, with the California samples second, and the Arizona-New Mexico-West Texas samples third.

From available information it is not possible to say whether the slightly greater length variation of the irrigated cotton samples was due to differences within and between cotton bolls and plants in a field, or whether it was due to inefficiency in the operation of the gins.

It is clear, from this discussion, that the answer to the question is nearly as variable as the subject. In any event, it can be said that this element of length variability is of secondary importance and by itself should give no real cause for concern.

(3) Is irrigated cotton weak? This question can be considered as referring to the strength of the fibers themselves or to that of the yarns, cords and fabrics made from them. Both angles of the subject are probably important enough to be discussed at some length.

In regard to yarn and cloth strength, most cotton mills fall into one of two groups: (1) those that must meet definite strength specifications, such as manufacturers of tire cord, mechanical fabrics, and (of especial importance at present) fabrics of all kinds for war orders; and (2) those that do not have to meet any strength specifications. The importance of strength to the first group is obvious. In normal times, most mills, however, fall in the second group, and all they want in a cotton is one that will "run well", and of which there is an ample supply at a low price.

In our discussions with manufacturers we got a variety of opinions regarding the strength performance of irrigated cotton. In two large mills it was stated definitely that to meet specifications with irrigated cotton, they had found it necessary to use staples from 1/16 to 3/32 inch longer than the rain-grown cottons they were using satisfactorily. This, they said, killed any price advantage that might otherwise have attracted them to irrigated growths. In other cases, mills that used 100 percent irrigated cotton or 50-50, or 40-60 mixtures of irrigated and rain-grown, were obtaining satisfactory "running qualities" and strengths of yarns and fabrics.

In the Department's tests, neither the Delta nor the California cottons produced yarns that were consistently stronger for all grades and staples. An average of all the yarns spun from each growth showed that the Arizona-New Mexico-Texas samples produced yarns about 5 percent weaker than the other two growths.

The story was somewhat different with respect to tire cord strength. Here the results of the tests showed the cord from the Delta cotton to be about 6 percent stronger than the California cord, and 8 percent stronger than the Arizona-New Mexico-Texas cord. Tire cord reflects to a greater degree the fiber strength of cotton than does single yarn strength, and the rain-grown cottons tested were found to be 4 or 5 percent stronger in fiber strength than the irrigated cottons.

Fabric strength tests made in the Department's study provide still another comparison of strength. For heavy sheeting, California irrigated cotton gave higher tensile strengths than Delta rain-grown cotton in two of the three staples, with a reverse situation in the third. Both growths gave definitely higher fabric strengths than the Arizona-New Mexico-Texas irrigated cotton.

From this discussion of strength, it is clear that the relationships will vary, depending upon whether one is considering fiber, yarn, cord, or fabric strengths. If it is necessary to draw an overall conclusion, then we must say that the bulk of the available evidence shows that rain-grown cotton is slightly stronger than irrigated.

(4) Are yarns spun from irrigated cotton rough and neppy? Unfortunately, the answer to this one seems to be "In most cases, yes, as compared

with rain-grown cotton." In fact this is the one item in which irrigated cotton seems to live up (or down) to its reputation among critics. Even here, there are exceptions. For example, in one mill that I visited recently, irrigated cotton was being combed, and this process removed practically all the neps in it. As a result, the yarns and fabrics were exceptionally clean and smooth. Note, however, that this was a fine goods mill using combers. In nearly every other case that I saw, the cotton was being put into carded goods (that is, without combing) and the yarns and fabrics were definitely neppy. Neps are usually so small that many of them pass through the cards without being removed by the wire clothing, and once they escape this machine they are in the yarns and fabrics permanently, unless the cotton is further cleaned by combing. The majority of cotton mills are not equipped with combers, however, as these machines are costly to install and operate.

The objection to neps in yarns and fabrics is chiefly due to the poorer appearance they cause, although the presence of neps in sewing thread would constitute an obvious mechanical disadvantage. Some cotton manufacturers say that neps are likewise detrimental in tire cord and mechanical fabrics, but this may be more psychological than real.

Neps show up in sheeting and other white fabrics in a way that gives an effect of cheapness instead of high quality. In colored fabrics, as will be discussed more fully in a few moments, they are even more noticeable.

In the Department's tests, the yarns and fabrics made from the irrigated cottons were noticeably of poorer appearance than those made from rain-grown cotton. It was quite easy in most cases to distinguish between the two growths in the gray, bleached, or dyed fabrics.

Lack of time prevents a detailed consideration of the causes for and physical make-up of neps. They are evidently formed during ginning and some cottons are more susceptible to nep formation than others.

(5) Is irrigated cotton "hard to spin"? In the past, isolated cases have come to our attention in which irrigated cotton was said to possess objectionable "running qualities" such as excess of short fiber, or "fly", a tendency toward roller lapping during the spinning processes, and excessive end breakage during spinning. From our recent discussions with mill men, however, not a single case was found where any difficulty was being experienced in these respects. There are numerous and varied theories in existence in regard to the advantages of both high and low humidities when spinning irrigated cotton. My own observation to date is that irrigated cotton behaves about like rain-grown cotton insofar as its spinning behavior is concerned. In our tests, detailed records were kept of the spinning behavior of each sample at each stage of manufacture, and a summary of these notes reveals that no difficulties were encountered in handling the cotton.

Curiously enough the only criticism of the spinning behavior of irrigated cotton heard in the course of the recent brief survey had to do with the packaging of the cotton. It appears that during the past year or two, a considerable quantity of irrigated cotton has been received in the Southeast in high density bales. Many of the mills that received such

cotton had neither the equipment nor the experience to handle these high density bales, and had to resort to various devices, some crude and others ingenious, to handle them. It is our understanding that this cotton was probably compressed to high density with the idea that it would be shipped by water, but that circumstances led to its being shipped overland to the Southeast. In any event, the difficulties were not very serious, and the mills understand that in the future such cotton will probably arrive in the form of the standard density bales that most of them desire.

(6) Does irrigated cotton present any special difficulties in regard to dyeing? Commercial dye houses have found that fabrics made from irrigated cotton do not absorb dye to the same degree as those made from rain-grown cotton. That is, when dyed in the same bath, the irrigated fabrics take a slightly lighter shade, generally speaking. It is a simple matter to alter the concentration of the dye bath to obtain the desired shade with 100 percent irrigated cotton, but if a fabric were made partly from irrigated and partly from rain-grown cotton, it is possible that a somewhat mottled effect might result in some cases.

This is probably the appropriate point at which to consider briefly the question of specifications for Government purchases. From time to time during the past 3 years, complaints have been received, usually from this area, that the Government is discriminating against irrigated cottons by stating in various specifications that it shall not be used. Within the last month, I have taken this matter up with those concerned in both the War and Navy Departments, and have been definitely advised that they do not have a single specification that prevents the use of irrigated cotton. In fact, these specifications deal with the strength and other characteristics of the fabrics, and with one exception do not relate to the raw cotton in any particular so far as we have been able to find. The one exception is War Department specification P.Q.D. No. 33-A, for uniform twill cloth, in which paragraph C-2a reads: "Cotton - The cotton shall be of suitable length of staple and grade to meet the requirements of this specification. When irrigation-grown cotton is used, it shall not be blended with other cottons at any stage in the manufacture of this fabric." Such a specification may not be out of order in view of the experiences of commercial dye houses in connection with this problem, although specifications relating only to the end product, without reference to irrigated cotton, should produce the desired effect.

The results of the Department's tests, which included the dyeing of many samples of both irrigated and rain-grown cotton fabrics with 7 different dye baths, confirm the findings of commercial dye houses.

More serious than the slight difference in shade is the difficulty caused by the presence of neps in dyed fabrics made from irrigated cotton. For some reason, these generally take on a considerably lighter shade of color, and become very prominent, particularly in the darker shades of fabric. The effect is anything but pleasing, and constitutes a serious objection to the cotton. A certain amount of assistance in overcoming this feature is obtained in some finishing plants by subjecting the fabric to a light mercerizing treatment prior to the dyeing process. This is said to result in a more uniform shade in neppy fabrics, but of course it adds to the cost

of producing the finished goods, and so it is not a universal practice.

This, then, is the story of what we have found to date about manufacturing quality of irrigated cotton. Taking the well-known criticisms one by one, we may summarize the matter as follows:

- (1) irrigated cotton is not consistently more wasteful than rain-grown cotton;
- (2) irrigated cotton appears to be slightly more irregular in staple than rain-grown cotton, length for length;
- (3) irrigated cotton is slightly weaker, on an average, in the strength of its fibers and of tire cord made from it, but not necessarily so in the form of yarns and fabrics;
- (4) the yarns and fabrics made from irrigated cotton are in most cases neppier and of somewhat poorer appearance than those made from rain-grown cotton. (At least one mill that we know of, however, is making combed fabrics of excellent quality from irrigated cotton.)
- (5) irrigated cotton is no more difficult to spin than rain-grown cotton;
- (6) although fabrics made from irrigated cotton appear to absorb dye to a somewhat different degree from rain-grown cotton, this can be easily corrected by simple changes in the dye baths. But mixtures of irrigated and rain-grown cotton when dyed may differ to the extent that an uneven or mottled effect is produced. The chief difficulty in this problem is that neps are prominent in many dyed fabrics because they usually assume a definitely lighter shade.

Is There a Solution to the Problem of Irrigated Cotton?

Experiments conducted by the U. S. Department of Agriculture lead us to believe that the difficulty with neps and the slightly weaker strength of irrigated cotton, is definitely associated with the variety of cotton that is grown. When seed from the strain of Acala, popular in the Southwest, are planted in various sections of the Belt where cotton is grown under rain-fall conditions, the resulting lint has been found by our laboratories to have practically the same characteristics it does when grown under irrigation. Moreover, limited experiments have shown that other varieties or strains of cotton from the rain-grown part of the Cotton Belt may produce, under irrigation, lint of a somewhat better quality than the currently grown strain of Acala.

In essence, therefore, the problem may be said to boil down to the question of whether the cotton growers of the Southwest are willing to continue to sacrifice quality, to the extent that they seem to have sacrificed it for the extremely high yields obtained in this general area.

There is another alternative, however--that of finding a cotton that will produce both superior yield and high quality, or through selective breeding, of eliminating the objectionable features of the present cotton. This program would include the planting of experimental plots with varieties

or strains that seem to hold promise, and the testing of the lint by some reliable mill or laboratory. In connection with the testing part of the job, some of you may know that the U. S. Department of Agriculture is now authorized and equipped to make fiber and spinning tests for cotton breeders and others, on a fee-per-sample basis. At least one producer-breeder of irrigated cotton has already taken advantage of this cotton testing service. Of the samples he has submitted to us, two appear to hold exceptional promise from the quality point of view.

Much more experimental work needs to be done by all concerned--not just by your State and Federal governments. In the meantime, do not forget that cultural and ginning practices have an important influence on quality. By concerted efforts to improve these phases of cotton production, you can certainly improve the average quality of your crop.

No one can say that a better cotton cannot be found for the Southwest, and it would certainly seem to be worth looking for. If and when you find a better cotton for this whole area, then you must conduct a carefully planned educational program to prove to the mills that you have it and to make them want it. And incidentally, don't forget to call it something beside "irrigated cotton" when the time comes!